Claims

1. A wiper blade for windows, in particular of motor vehicles, with at least one support element (12), a wiper strip (14), and a connecting device (16) for a wiper arm (18), wherein the support element (12) is an elongated, flat bar to which the wiper strip (14) and the connecting device (16) are attached, characterized in that the support element (12) has a cross sectional profile in which

$$\frac{F_{wf} * L^2}{48 * E * I_{zz}} < 0.009 ,$$

where F_{wf} is the contact force exerted on the wiper blade by the wiper arm (18) or is the contact force for which the wiper blade was originally designed, L is the length of the support element (12), E is the elasticity modulus of the support element (12), and I_{zz} is the moment of inertia of the cross sectional profile around the z-axis perpendicular to an s-axis, which adapts along with the support element (12), and perpendicular to a y-axis.

2. The wiper blade according to claim 1, characterized in that

$$\frac{F_{wf} * L^2}{48 * E * I_{zz}} < 0.005 .$$

3. The wiper blade according to claim 1 or 2, characterized in that the support element (12) has an essentially rectangular cross sectional profile (40), with

an essentially constant width b and an essentially constant thickness d.

4. The wiper blade according to one of the preceding claims, characterized in that the support element (12) is comprised of at least two individual bars (42, 44) and that the widths (b1, b2) of the individual bars (42, 44) add up to a total width b.

5. The wiper blade according to one of the preceding claims, characterized in that the width b and the thickness d of the support element (12) are selected so that

$$\frac{F_{wf} * L^2}{4 * E * d * b^3} < 0.009 .$$

6. The wiper blade according to one of claims 1 to 4, characterized in that the width b and the thickness d of the flat bar are selected so that

$$\frac{F_{wf} * L^2}{4 * E * d * b^3} < 0.005 .$$

7. A wiper blade for windows, in particular of motor vehicles, with at least one support element (12), a wiper strip (14), and a connecting device (16) for a wiper arm (18), wherein the support element (12) is an elongated, flat bar to which the wiper strip (14) and the connecting device (16) are attached, in particular according to one of the preceding claims, characterized in that the support element (12) has a cross sectional profile (40) which produces a

lateral deflection angle of at least one of the support element ends in relation to the longitudinal span of the support element of $\gamma < 0.5°$, in particular $< 0.3°$ against the window (26), when the wiper blade is moved on the window (26) lateral to its longitudinal span, and the friction coefficient between the window (26) and the wiper strip (14) is approximately 1.

8. A wiper blade for windows, in particular of motor vehicles, with at least one support element (12), a wiper strip (14), and a connecting device (16) for a wiper arm (18), wherein the support element (12) is an elongated, flat bar to which the wiper strip (14) and the connecting device (16) are attached, in particular according to one of the preceding claims, characterized in that the support element has a length L, a width b, and a thickness d such that

$$20L^2 < bd^2 < 40L^2$$

in which L is given in meters and b and d are given in millimeters.

9. The wiper blade according to claim 8, characterized in that the support element is comprised of two spring bars whose widths are added to each other.

10. A wiper blade for windows (15), in particular of motor vehicles, with at least one elongated support element (12), a wiper strip (14), and a connecting device (16) for a wiper arm (18) which presses the wiper blade (10) against the window (15) in an operating position, wherein the support element (12) is an elongated, flat bar to which the

wiper strip (14) and the connecting device (16) are attached, and which has a curvature when it is not loaded by the wiper arm (18), in particular according to one of the preceding claims, characterized in that the curvature along a coordinate (s), which follows the longitudinal span of the support element (12), has values such that the second derivative of the curvature as a function of this coordinate (s) is essentially proportional to a contact force distribution p (s), which is produced when the wiper blade (10) is pressed against a flat window (15), and that the contact force distribution decreases toward at least one end.

11. The wiper blade according to claim 10, characterized in that

$$\frac{d^2K(s)}{ds^2} = \frac{d^2M(s)}{ds^2} * E * I = \frac{p(s)}{E*I}$$

s = coordinate along the support element
K(s) = curvature of the support element
M(s) = bending moment
E = elasticity modulus
I = surface moment of inertia of the support element in relation to the neutral axis
p(s) = specific force per unit length = contact force distribution.

12. A wiper blade for windows (15), in particular of motor vehicles, with at least one elongated support element (12), a wiper strip (14), and a connecting device (16) for a wiper arm (18) which presses the wiper blade (10) against

the window (15) in an operating position, wherein the support element (12) is an elongated, flat bar to which the wiper strip (14) and the connecting device (16) are attached, and which has a curvature when it is not loaded by the wiper arm (18), in particular according to one of the preceding claims, characterized in that the curvature along a coordinate (s), which follows the longitudinal span of the support element (12), has values such that the second derivative of the curvature as a function of this coordinate (s) minus the second derivative of the curvature of the window (15) decreases from a middle region (40) toward the ends.

13. The wiper blade according to claim 12, characterized in that the middle region (40) is the location of the connecting device (16).

14. The wiper blade according to one of claims 12 or 13, characterized in that

$$\frac{d^2K(s)}{ds^2} = \frac{p(s)}{E*I} + \frac{d^2K_{window}(s)}{ds^2}$$

s = coordinate along the support element
K(s) = curvature of the support element
M(s) = bending moment
E = elasticity modulus
I = surface moment of inertia of the support element in relation to the neutral axis
p(s) = specific force per unit length = contact force distribution.

15. A wiper blade for windows (15), in particular of motor vehicles, with at least one elongated support element (12), a wiper strip (14), and a connecting device (16) for a wiper arm (18) which presses the wiper blade (10) against the window (15) in an operating position, wherein the support element (12) is an elongated, flat bar to which the wiper strip (14) and the connecting device (16) are attached, and which has a curvature when it is not loaded by the wiper arm (18), in particular according to one of the preceding claims, characterized in that the curvature along a coordinate (s), which follows the longitudinal span of the support element (12), has values such that the contact force distribution p (s), which prevails when the wiper blade (10) is pressed against a flat window (15) is greater in a region (40) approximately halfway between the center and the end of the wiper blade (10) than it is at the end of the wiper blade (10).

16. A wiper blade for windows (15), in particular of motor vehicles, with at least one elongated support element (12), a wiper strip (14), and a connecting device (16) for a wiper arm (18) which presses the wiper blade (10) against the window (15) in an operating position, wherein the support element (12) is an elongated, flat bar to which the wiper strip (14) and the connecting device (16) are attached, and which has a curvature when it is not loaded by the wiper arm (18), in particular according to one of the preceding claims, characterized in that the curvature along a coordinate (s), which follows the longitudinal span of the support element (12), has values such that the contact force distribution p (s), which prevails when the wiper blade (10) is pressed against the window (15) to be wiped, is greater in a region (40) approximately halfway between the center

and the end of the wiper blade (10) than it is at the end of the wiper blade (10).

17. A method for producing a wiper blade according to one of the preceding claims, characterized by means of the following process steps:
determination of the length L and adapted contact force F_{wf} required for the window to be wiped,
determination of the width b and the thickness d,
determination of the curvature progression K(s),
bending of the support element,
connection of the support element, wiper strip, and connecting device.

18. The method according to claim 17, characterized by means of the following process steps:

- determination of the length L and the cross sectional profile, particularly the width b and the thickness d by means of experimental values,
- determination of a contact force F_{wf} and a contact force distribution p for a flat window, which assures a favorable wiping quality, likewise by means of experimental values,
- measurement of the curvature progression K_{window} of the window,
- double derivation of this curvature progression K_{window} of the window as a function of a coordinate that adapts along with the curvature,
- calculation of the second derivative of the curvature progression K(s) of the support element according to the above relation,
- double integration yields the desired curvature progression K(s) of the support element.